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**COSTS OF ALTERNATIVE DAIRY MANURE HANDLING SYSTEMS**

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## **COSTS OF ALTERNATIVE DAIRY MANURE HANDLING SYSTEMS**

Recent legislation proposed by the Ohio legislature would require many dairy farmers to file manure handling plans and change manure handling practices. This legislation, along with general heightened environmental awareness, has increased interest in alternative manure handling systems. This paper presents annual cost estimates of alternative manure systems commonly used by dairy farmers. Presentation of this material has two purposes. First, these cost estimates can be used as guidelines when considering alternative manure systems. Second, annual costs for existing facilities can be compared against various "innovative" manure systems to determine the economic feasibility of the "innovative" system.

We describe the manure management facilities in the following section. Then, methods for determining costs of alternative systems are presented in the second. The results section then summarizes the cost estimates. Particular attention is given to economies of size, labor use, and fully using nutrients contained in manure.

### **MANURE HANDLING SYSTEMS**

Four types of dairy housing facilities are studied: 1) confined free stall, 2) open lot with free stall, 3) stanchion barn, and 4) confined free stall with flush. Various manure disposal methods, storage methods, and manure application methods were examined for each housing facility.

## **Confined Free Stalls**

We examined a range of manure handling systems for confined free stall facilities. Alternative methods of manure collection, storage, and spreading are considered. Of the 12 confined free stall systems considered, four assume manure collection using tractor scraping. Six of the systems automate manure collection by replacing the tractor scraper with a mechanical alley scraper and cross-gutter cleaner. Two systems use slotted floors in alleys to collect manure in storage pits. For each collection technology, the most common storage alternatives (i.e. plank, earthen, concrete pit, and silo) are used. Finally, surface spreading and manure plowdown are alternative spreading methods considered.

Costs and returns are estimated for each of the following twelve confined free stall systems using an economic engineering approach.

1. Tractor scrape
  - a. daily spread
  - b. 6 month plank storage
2. Tractor scrape, concrete pit storage (6 month)
  - a. surface spread
  - b. manure plowdown
3. Slotted floor, concrete pit storage (6 months)
  - a. surface spread
  - b. manure plowdown
4. Mechanical scrape, piston pump, earthen storage (6 months)
  - a. surface spread
  - b. manure plowdown
5. Mechanical scrape, piston pump, silo storage (6 months)
  - a. surface spread
  - b. manure plowdown

6. Mechanical scrape, concrete pit storage (6 months)
  - a. surface spread
  - b. manure plowdown

### **Free Stall Open Lot**

An open lot with a free stall facility may be used to provide additional space for the cattle or to allow extra feeding space. The farmer must also consider pollution due to runoff and take measures to control runoff. By building a curb on the paved lot the runoff can be channeled into the storage basin.

A treated plank wall structure may be used to store the manure from a free stall operation if the farmer decides to handle the manure as a solid. The plank storage structure does not need a roof; however, provisions need to be made for runoff control.

Costs and returns are estimated for the following open lot, free stall systems.

1. Tractor scrape, solid spreading
  - a. surface spread
  - b. surface spread with diversion, settling basin, and grass infiltration area
  - c. surface spread with diversion, settling basin, lagoon, and wastewater irrigation
2. Tractor scrape, piston pump, earthen storage
  - a. surface spread
  - b. plowdown

### **Stanchion Barn**

In a stanchion barn with a conventional gutter cleaner, the manure spreader is directly loaded by the gutter cleaner/elevator. Small dairy farms often use this daily hauling method. If periodic spreading is preferred, a stacker (elevator) may be used to

move the manure to storage until spreading time. Storage options considered are plank or concrete storage. A variation of this system is to have slotted floor alleyways with the storage pits beneath the slats.

Costs and returns are estimated for the following confinement stall systems.

Gutter cleaner with elevator or stacker

- a. daily spreading
- b. surface spread, 6 months above ground concrete storage
- c. 6 months above ground concrete storage, and plowdown
- d. surface spread, 6 months plank storage
- e. 6 month plank storage, and plowdown

### **Confined Free Stall Flush**

Finally, a confined free stall facility with a flushing system can be used in warmer climates. In this type of housing facility the alleyways are flushed into a cross-gutter and the wastewater flows into a two-stage lagoon. The water used to flush the alleyway is recycled from the second lagoon. Yearly irrigation of the lagoon is required to control the dissolved salts in the wastewater. Also, sludge needs to be removed every three to five years.

Costs and returns are estimated for the following confined free stall systems with gutter flush.

1. Flush, anaerobic lagoon (6 month storage)
  - a. surface spread
  - b. surface spread with solid separation
2. Flush, earthen storage (limited storage is provided)

## **DETERMINING COSTS AND RETURNS FOR EACH SYSTEM**

Yearly costs of each manure management system are estimated using an economic engineering approach. Only costs and returns directly associated with the manure handling system are included. These included labor, power, facility investment, and nutrients produced by the cow. Excluded are such items as potential variations in livestock performance across systems, modifications to other systems required by implementing the manure system, and impacts that alternatives may have on timeliness of crop operations.

The economic engineering approach requires two steps. First components of a system are determined. Components include 1) labor necessary to maintain the system, move manure into storage, and apply manure to fields, 2) energy required to operate the system, 3) fixed facilities, and 4) quantity of nutrients produced. Second, each component's yearly costs are determined using 1990 prices.

An example of this procedure is presented in table 1. This table shows costs and returns for a 100 cow confined free stall facility with slotted floors, pit storage, and surface spreading of manure. The first column, labeled components, gives the physical make-up of the system. Most component data are obtained from White and Forster. The second column gives the quantities required for each component. For example, 396 hours of labor are used in a year. The third column gives the new costs of investment in fixed facilities. Fixed investments only include items exclusively used in the manure system. For example, the concrete slats and the concrete pit only relate to the manure system. On the other hand, a tractor may be used in other farm operations. Tractors

are not treated as fixed investments because such treatment would overcharge the manure system.

The column labeled annual costs gives each component's yearly costs on a per cow basis. One of two methods is used to calculate annual per cow costs, depending on whether the component is a non-capital or a capital item. Costs of non-capital items are determined by multiplying the quantity used times a 1990 price, and then dividing the result by the number of cows. For example, the \$32 annual cost results from the multiplication of 396 hours by an \$8 labor cost per hour, and then dividing by 100 cows. Prices for all non-capital items are listed in table 2.

Annual per cow costs for capital items are calculated as a percentage of capital investment. For example, the factor used for the concrete slats equalled .17. Annual costs equalled \$8 per cow ( $\$4,576 \text{ investment} \times .17 \text{ factor} / 100 \text{ cows}$ ). Factors are listed in table 3 under the column labeled "total." Total factors are the sum of costs for depreciation, repairs, interest, and insurance. Percentages for each of these columns are listed in the latter four columns. Depreciation varied across machine types depending on the estimated useful life of the machine. Depreciation factors are found by dividing 1 by the estimated useful life. Repair percentages were taken from White and Forster. The interest rate is assumed to equal 10 percent. The annual interest rate is assumed to equal 10 percent. The 0.5 factor shown in the table results from dividing 10 percent by 2. Insurance costs equal one percent of the 1990 value.

The "annual returns" column (table 1) gives returns from nutrients. These are determined by multiplying the pounds of per cow production per year times the 1990

prices. Prices for the nutrients are shown in table 2. The final column lists costs and returns.

We also calculate the variable and fixed portions of total cost for each system. It is assumed that all non-capital items are variable and all capital items are fixed.

## **RESULTS**

The net system returns for each of the systems listed above are calculated and are shown in appendix tables A-1 through A-55. The appendix tables show all the costs and returns of the systems. Therefore, they can be used when comparing alternative manure handling systems.

Tables 4 through 7 summarize the appendix tables and group them by housing type. Net system returns are calculated by subtracting the variable and fixed costs from the value of the available nutrients.

### **Confined Free Stall**

Table 4 contains the net system returns for the confined free stall systems. The basic system of tractor scrape and daily spread is the least expensive. For the 100 cow herd, the annual net system cost is \$135 per cow year and is \$115 per cow year for the 200 cow herd.

As storage and mechanical scrapers are added to the system, the net system costs increase. For example, by adding pit storage to the basic system, net system cost for the



100 cow herd increases from \$135 to \$219 per cow year. By adding pit storage and mechanical scrape, the system cost for the 100 cow herd increases to \$260 per cow year.

For systems with storage, plowdown or soil incorporation can offset some of the increased costs from storage because more nutrients are available for use. For example, when surface spread is replaced by plowdown in the tractor scrape and pit storage system for the 100 cow herd, the annual net cost is decreased from \$219 to \$211 per cow year. Plowdown also reduces the net system cost for the mechanical scrape and slotted floor systems by approximately \$8 per cow year.

### **Open Lot, Free Stall**

Table 5 shows the net system returns for the open lot, free stall systems. The open lot, free stall systems include tractor scrape with daily spread and tractor scrape with piston pump and earthen storage systems. For pollution control of runoff, the tractor scrape with daily spread system is modified with grass infiltration or detention/irrigation systems. These methods require a higher capital investment thereby increasing the fixed costs per cow year.

For the 100 cow herd, the net system cost ranges from \$105 per cow year for the base tractor scrape with daily spread to \$197 per cow year for the tractor scrape with piston pump, earthen storage and surface spread. Fixed costs make up the majority of the difference in the costs of these systems. Fixed costs of the base system is only \$49 while the fixed costs of the earthen storage system is \$108.

## **Stanchion Barn**

The net system returns for the stanchion barn systems are shown in table 6. The three confinement systems considered are the gutter cleaner with daily spread, the gutter cleaner with stacker and plank storage, and the gutter cleaner with piston pump and concrete storage. Annual net system costs for these systems are slightly lower than confined free stall systems.

The net system cost for the 100 cow herd using gutter cleaner and daily spread is \$136 per cow year. By adding plank storage the net system cost is \$178 per cow year. As with other systems with storage, the net system cost is reduced by approximately \$8 when plowdown or soil incorporation is employed. The gutter cleaner with piston pump and concrete storage is relatively expensive for the 50 cow herd with a net system cost of \$256 per cow year. As the herd size increases to 100 cows, the net system cost decreases to \$134 per cow year and becomes competitive with other confinement stall systems.

## **Confined Free Stall Flush**

Table 7 shows the system returns for the confined free stall with flush. These systems are used in large herds and have relatively low per cow year costs due to economies of size. The net system cost for a 200 cow herd using free stall with lagoon and wastewater irrigation system is \$38 per cow year.

By installing a temporary earthen storage system rather than a lagoon, the system cost for a 200 cow herd decreases to a net system cost of \$4 per cow year. The earthen storage allows wastewater to be applied to the fields immediately and results in higher

available nutrients. Also, the earthen storage requires less capital than a lagoon resulting in lower fixed costs.

The net system costs for the free stall with solid separation, lagoon and wastewater irrigation system for a 200 cow herd is \$71 per cow year. This system requires more capital than the previous flush systems resulting in higher fixed costs. Also, there are fewer nutrients available for land application.

### **Economies of Size**

Economies of size exist in almost all of the manure handling systems discussed above. Figure 1 illustrates economies of size for confined free stall systems. As the number of animals increases, the net cost per cow year decreases. Some systems that exhibit economies of size have relatively high net costs per cow year at small herd sizes. Therefore, different manure handling systems may be recommended for small farms and large farms.

### **Use of Available Nutrients**

Farmers sometime apply manure in excess of the nutrient requirements of the soil. Therefore, some of the nutrients available go unused. By applying nutrients to fields at rates that do not exceed crop requirements, nutrients are fully utilized and nutrient benefits are at their maximum. For example, the net system cost for a confined free stall with tractor scrape and daily spread system for a 100 cow herd at 50 percent

usage of available nutrients is \$166 per animal. However, at 100 percent usage of available nutrients the net system cost is \$135 per cow year.

### **SUMMARY**

All of the manure handling systems described in this study require a substantial investment. Therefore, serious consideration should be given to the economic results of modifying a manure handling system or choosing a new system. Modifications of an existing manure handling system can be made relatively inexpensively; however, major changes may require a large additional investment.

By using plowdown or soil incorporation with any system that has storage, the net system cost is reduced due to a higher amount of nutrients available for use by the soil. Also, this reduces the labor cost because manure will not need to be spread every day. Techniques that maximize the amount of nutrients utilized by the soil should be considered so that benefits are not lost.

Finally, economies of size exist in manure handling systems. As the herd size increases, the net system cost per cow year decreases resulting in an advantage for larger farmers. However, other factors should be considered when choosing a manure handling system, i.e. feeding system, existing facilities. Recommendations of the best manure handling system should only be made on a individual farm basis.

## REFERENCE

White, R.K., and D.L. Forster. A Manual On: Evaluation and Economic Analysis of Livestock Waste Management Systems. Environmental Protection Agency, May 1978.

TABLE 1. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, SLOTTED FLOOR,  
PIT STORAGE, SURFACE SPREAD, 100 COWS

| Component         | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|-------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor             | 396 hrs      |                               | 32                            |                                  | -32  |
| Tractor           | 355 hrs      |                               | 81                            |                                  | -81  |
| Energy            | 5000 kw      |                               | 6                             |                                  | -6   |
| Agitate/load pump | 1            | 6720                          | 21                            |                                  | -21  |
| Concrete slats    | 1450 ft2     | 4576                          | 8                             |                                  | -8   |
| Concrete pit      | 33000 ft3    | 67496                         | 81                            |                                  | -81  |
| Pit ventilation   | 1            | 1155                          | 4                             |                                  | -4   |
| Tank wagon        | 1            | 11340                         | 28                            |                                  | -28  |
| Nutrients         |              |                               |                               |                                  |  |
| N                 | 116 lb/an yr |                               |                               | 23                               | 23   |
| P2O5              | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K2O               | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total             |              | 91287                         | 259                           | 59                               | -200                                       |

TABLE 2. UNIT PRICES OF VARIABLE INPUTS AND OUTPUT.

|           |                     |
|-----------|---------------------|
| Labor     | \$ 8 per hour       |
| Tractor   | \$ 15 per hour      |
| Energy    | \$0.12 per kilowatt |
| Nitrogen  | \$0.20 per pound    |
| Phosphate | \$0.22 per pound    |
| Potash    | \$0.13 per pound    |

TABLE 3. PERCENTAGES USED FOR CALCULATING ANNUAL COSTS FOR FIXED ASSETS

| Component                   | Component Number | Estimated Useful Life | Assumed Annual Costs<br>(% of original investment) |              |         |          |           |
|-----------------------------|------------------|-----------------------|--|--------------|---------|----------|-----------|
|                             |                  |                       | Total  | Depreciation | Repairs | Interest | Insurance |
| Concrete floor              | 1.00             | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Concrete lot                | 2.00             | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Concrete pit                | 3.00             | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Concrete flume (swine)      | 4.00             | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Concrete slats              | 5.00             | 10.00                 | 0.17   | 0.10         | 0.01    | 0.05     | 0.01      |
| Concrete settling basin     | 6.00             | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Concrete upground tanks     | 7.00             | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Concrete flume (beef)       | 8.00             | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Earthen settling basin      | 12.00            | 20.00                 | 0.13   | 0.05         | 0.02    | 0.05     | 0.01      |
| Earthen detention basin     | 12.00            | 20.00                 | 0.13   | 0.05         | 0.02    | 0.05     | 0.01      |
| Earthen storage basin       | 13.00            | 20.00                 | 0.13   | 0.05         | 0.02    | 0.05     | 0.01      |
| Lagoon                      | 14.00            | 20.00                 | 0.13   | 0.05         | 0.02    | 0.05     | 0.01      |
| Diversion terrace           | 15.00            | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Grassed infiltration area   | 16.00            | 20.00                 | 0.12   | 0.05         | 0.01    | 0.05     | 0.01      |
| Tractor scraper             | 26.00            | 10.00                 | 0.19   | 0.10         | 0.03    | 0.05     | 0.01      |
| Mechanical alleyway scraper | 27.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Mechanical cage scraper     | 28.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Gutter cleaner              | 29.00            | 10.00                 | 0.21   | 0.10         | 0.05    | 0.05     | 0.01      |
| Gutter cleaner (elevator)   | 30.00            | 10.00                 | 0.21   | 0.10         | 0.05    | 0.05     | 0.01      |
| Gutter cleaner (stacker)    | 31.00            | 10.00                 | 0.21   | 0.10         | 0.05    | 0.05     | 0.01      |
| Stacker                     | 32.00            | 10.00                 | 0.21   | 0.10         | 0.05    | 0.05     | 0.01      |
| Tractor scraper (poultry)   | 33.00            | 10.00                 | 0.19   | 0.10         | 0.03    | 0.05     | 0.01      |
| Front end loader            | 34.00            | 10.00                 | 0.19   | 0.10         | 0.03    | 0.05     | 0.01      |
| Tractor skid loader         | 35.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Cage pan scraper            | 36.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Box spreader (with storage) | 41.00            | 10.00                 | 0.21   | 0.10         | 0.05    | 0.05     | 0.01      |
| Vacuum tank wagon           | 42.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Tank wagon                  | 43.00            | 7.00                  | 0.24   | 0.14         | 0.04    | 0.05     | 0.01      |
| Truck box spreader          | 44.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Truck tank spreader         | 45.00            | 7.00                  | 0.24   | 0.14         | 0.04    | 0.05     | 0.01      |
| Injector                    | 46.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Box spreader (daily spread) | 57.00            | 5.00                  | 0.31   | 0.20         | 0.05    | 0.05     | 0.01      |
| Siphon Tank                 | 51.00            | 10.00                 | 0.19   | 0.10         | 0.03    | 0.05     | 0.01      |
| Tipping Tank                | 52.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Gated Tank                  | 53.00            | 10.00                 | 0.21   | 0.10         | 0.05    | 0.05     | 0.01      |
| Recycle Pump                | 60.00            | 5.00                  | 0.31   | 0.20         | 0.05    | 0.05     | 0.01      |
| Piston Pump                 | 61.00            | 7.00                  | 0.24   | 0.14         | 0.04    | 0.05     | 0.01      |
| Agitate/Load Pump           | 62.00            | 5.00                  | 0.31   | 0.20         | 0.05    | 0.05     | 0.01      |
| Irrigation System (waste)   | 66.00            | 7.00                  | 0.25   | 0.14         | 0.05    | 0.05     | 0.01      |
| Irrigation System (runoff)  | 67.00            | 10.00                 | 0.20   | 0.10         | 0.04    | 0.05     | 0.01      |
| Oxidation Ditch Rotor       | 71.00            | 4.00                  | 0.36   | 0.25         | 0.05    | 0.05     | 0.01      |
| Floating Aerator            | 72.00            | 5.00                  | 0.30   | 0.20         | 0.04    | 0.05     | 0.01      |
| Dehydrator                  | 76.00            | 5.00                  | 0.31   | 0.20         | 0.05    | 0.05     | 0.01      |
| Pit Ventilation             | 81.00            | 5.00                  | 0.31   | 0.20         | 0.05    | 0.05     | 0.01      |
| Land                        | 82.00            |                       | 0.13   |              | 0.02    | 0.10     | 0.01      |

TABLE 4. DAIRY, CONFINED FREE STALL, ANNUAL RETURNS AND COSTS FOR ALTERNATIVE WASTE MANAGEMENT SYSTEMS USING TRACTOR SCRAPE

| Waste Management System<br>(1)                         | System Modification<br>(2) | Herd Size (Head Capacity)<br>(3) | Returns to Nutrients<br>(4) | Variable Costs<br>(5) | Fixed Costs<br>(6) | Net System Returns<br>(4)-(5)-(6) | Appendix Reference |
|--|----------------------------|----------------------------------|-----------------------------|-----------------------|--------------------|-----------------------------------|--------------------|
| (Dollars per Cow Year)                                 |                            |                                  |                             |                       |                    |                                   |                    |
| Tractor scrape, daily spread                           | Surface Spread             | 50                               | 61                          | 184                   | 62                 | -185                              | A-1                |
|  | Surface Spread             | 100                              | 61                          | 148                   | 48                 | -135                              | A-2                |
|  | Surface Spread             | 200                              | 61                          | 140                   | 35                 | -114                              | A-3                |
| Tractor scrape, plank storage (6 month)                | Surface Spread             | 50                               | 65                          | 184                   | 89                 | -208                              | A-4                |
|  | Surface Spread             | 100                              | 65                          | 135                   | 73                 | -143                              | A-5                |
|  | Surface Spread             | 200                              | 65                          | 124                   | 56                 | -115                              | A-6                |
| Tractor scrape, pit storage (6 month)                  | Surface Spread             | 50                               | 59                          | 190                   | 137                | -268                              | A-7                |
|  | Plowdown                   | 50                               | 68                          | 190                   | 137                | -259                              | A-8                |
|  | Surface Spread             | 100                              | 59                          | 179                   | 100                | -220                              | A-9                |
|  | Plowdown                   | 100                              | 68                          | 179                   | 100                | -211                              | A-10               |
|  | Surface Spread             | 200                              | 59                          | 130                   | 74                 | -145                              | A-11               |
|  | Plowdown                   | 200                              | 68                          | 130                   | 74                 | -136                              | A-12               |
| Slotted floor, pit storage (6 month)                   | Surface Spread             | 100                              | 59                          | 119                   | 141                | -201                              | A-13               |
|  | Plowdown                   | 100                              | 68                          | 119                   | 141                | -192                              | A-14               |
| Mechanical scrape, piston pump, earthen storage        | Surface Spread             | 50                               | 59                          | 197                   | 193                | -331                              | A-15               |
|  | Plowdown                   | 50                               | 68                          | 197                   | 193                | -322                              | A-16               |
|  | Surface Spread             | 100                              | 59                          | 152                   | 124                | -217                              | A-17               |
|  | Plowdown                   | 100                              | 68                          | 152                   | 124                | -208                              | A-18               |
|  | Surface Spread             | 200                              | 59                          | 111                   | 82                 | -134                              | A-19               |
|  | Plowdown                   | 200                              | 68                          | 111                   | 82                 | -125                              | A-20               |
| Mechanical scrape, piston pump, silo storage (3 month) | Surface Spread             | 100                              | 59                          | 112                   | 135                | -188                              | A-21               |
|  | Plowdown                   | 100                              | 68                          | 112                   | 135                | -179                              | A-22               |
| Mechanical scrape, pit storage (6 month)               | Surface Spread             | 100                              | 59                          | 147                   | 172                | -260                              | A-23               |
|  | Plowdown                   | 100                              | 68                          | 147                   | 172                | -251                              | A-24               |



TABLE 5. DAIRY, FREE STALL OPEN LOT, ANNUAL RETURNS AND COSTS FOR ALTERNATIVE WASTE MANAGEMENT SYSTEMS WITHOUT STORAGE

| Waste Management System<br>(1)               | System Modification<br>(2)  | Herd Size<br>(Head Capacity)<br>(3) | Returns to Nutrients<br>(4) | Variable Costs<br>(5) | Fixed Costs<br>(6) | Net System Returns<br>(4)-(5)-(6) | Appendix Reference |
|--|-----------------------------|-------------------------------------|-----------------------------|-----------------------|--------------------|-----------------------------------|--------------------|
| (Dollars per Cow Year)                       |                             |                                     |                             |                       |                    |                                   |                    |
| Tractor scrape, daily spread, surface spread | Base                        | 50                                  | 61                          | 131                   | 63                 | -133                              | A-35               |
|  | Runoff control-infiltration | 50                                  | 61                          | 132                   | 65                 | -136                              | A-36               |
|  | Runoff control-detention    | 50                                  | 61                          | 135                   | 81                 | -155                              | A-37               |
|  | Base                        | 100                                 | 61                          | 117                   | 49                 | -105                              | A-38               |
|  | Runoff control-infiltration | 100                                 | 61                          | 118                   | 51                 | -108                              | A-39               |
|  | Runoff control-detention    | 100                                 | 61                          | 119                   | 60                 | -118                              | A-40               |
|  | Base                        | 200                                 | 61                          | 83                    | 35                 | -57                               | A-41               |
|  | Runoff control-infiltration | 200                                 | 61                          | 83                    | 37                 | -59                               | A-42               |
|  | Runoff control-detention    | 200                                 | 61                          | 86                    | 41                 | -66                               | A-43               |
| Tractor scrape, piston pump, earthen storage | Surface Spread              | 100                                 | 59                          | 149                   | 108                | -198                              | A-44               |
|  | Plowdown                    | 100                                 | 68                          | 149                   | 108                | -189                              | A-45               |
|  | Surface Spread              | 200                                 | 59                          | 123                   | 75                 | -139                              | A-46               |
|  | Plowdown                    | 200                                 | 68                          | 123                   | 75                 | -130                              | A-47               |

TABLE 6. DAIRY, STANCHION BARN, ANNUAL RETURNS AND COSTS FOR ALTERNATIVE WASTE MANAGEMENT SYSTEMS

| Waste Management System<br>(1)                                   | System Modification<br>(2) | Herd Size<br>(Head Capacity)<br>(3) | Returns to Nutrients<br>(4) | Variable Costs<br>(5) | Fixed Costs<br>(6) | Net System Returns<br>(4)-(5)-(6) | Appendix Reference |
|--|----------------------------|-------------------------------------|-----------------------------|-----------------------|--------------------|-----------------------------------|--------------------|
| (Dollars per Cow Year)   |                            |                                     |                             |                       |                    |                                   |                    |
| Gutter cleaner,<br>daily spread                                  | Surface Spread             | 50                                  | 61                          | 129                   | 78                 | -146                              | A-25               |
|  | Surface Spread             | 100                                 | 61                          | 128                   | 68                 | -135                              | A-26               |
| Gutter cleaner,<br>stacker,<br>plank storage<br>(6 month)        | Surface Spread             | 50                                  | 64                          | 108                   | 131                | -175                              | A-31               |
|  | Plowdown                   | 50                                  | 69                          | 108                   | 131                | -170                              | A-32               |
|  | Surface Spread             | 100                                 | 64                          | 133                   | 109                | -178                              | A-33               |
|  | Plowdown                   | 100                                 | 69                          | 133                   | 109                | -173                              | A-34               |
| Gutter cleaner,<br>piston pump,<br>concrete storage<br>(6 month) | Surface Spread             | 50                                  | 64                          | 110                   | 210                | -256                              | A-27               |
|  | Plowdown                   | 50                                  | 72                          | 110                   | 210                | -248                              | A-28               |
|  | Surface Spread             | 100                                 | 64                          | 50                    | 148                | -134                              | A-29               |
|  | Plowdown                   | 100                                 | 72                          | 50                    | 148                | -126                              | A-30               |

TABLE 7. DAIRY, FLUSH SYSTEMS, ANNUAL RETURNS AND COSTS FOR ALTERNATIVE WASTE MANAGEMENT SYSTEMS

| Waste Management System<br>(1)                                 | System Modification<br>(2) | Herd Size (Head Capacity)<br>(3) | Returns to Nutrients<br>(4) | Variable Costs<br>(5) | Fixed Costs<br>(6) | Net System Returns<br>(4)-(5)-(6) | Appendix Reference |
|--|----------------------------|----------------------------------|-----------------------------|-----------------------|--------------------|-----------------------------------|--------------------|
| (Dollars per Cow Year)   |                            |                                  |                             |                       |                    |                                   |                    |
| Free stall, lagoon, waste-water irrigate                       | Base                       | 200                              | 29                          | 13                    | 54                 | -38                               | A-48               |
|  |                            | 500                              | 29                          | 8                     | 46                 | -25                               | A-49               |
| Free stall, earthen storage, wastewater irrigate               | Base                       | 200                              | 59                          | 17                    | 46                 | -4                                | A-50               |
|  |                            | 500                              | 59                          | 17                    | 39                 | 3                                 | A-51               |
| Free stall, solid separation, lagoon, wastewater irrigate      | Base                       | 200                              | 23                          | 12                    | 82                 | -71                               | A-52               |
|  |                            | 500                              | 23                          | 10                    | 77                 | -64                               | A-53               |
| Pasture year around, flush milking center, wastewater irrigate | Base                       | 200                              | 4                           | 5                     | 33                 | -34                               | A-54               |
|  |                            | 500                              | 4                           | 5                     | 26                 | -27                               | A-55               |

Figure 1. Yearly Net System Costs of Manure Handling System for Confined Free Stall Housing and Surface Manure Spreading

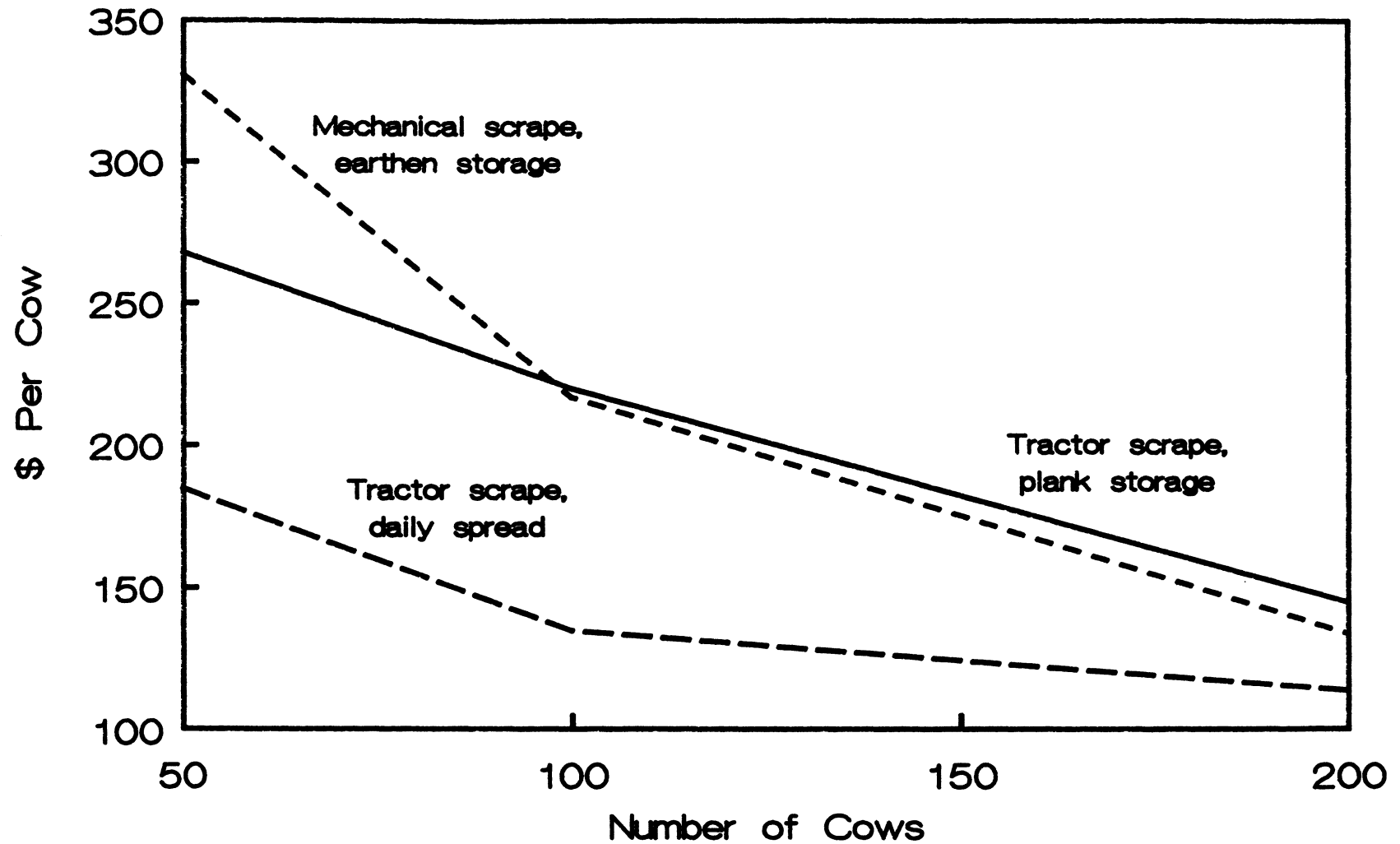


TABLE A-1. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, 50 COWS

| Component              | Quantity               | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|------------------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 400 hrs                |                               | 64                            |                                  | -64  |
| Tractor                | 400 hrs                |                               | 120                           |                                  | -120                                       |
| Energy                 | 0 kw                   |                               | 0                             |                                  | 0  |
| Tractor scraper/loader | 1                      | 5670                          | 22                            |                                  | -22  |
| Concrete floor         | 55 ft <sup>2</sup> /an | 5305                          | 13                            |                                  | -13  |
| Box spreader/daily use | 1                      | 4515                          | 28                            |                                  | -28  |
| Nutrients              |                        |                               |                               |                                  |  |
| N                      | 124 lb/an yr           |                               |                               | 25                               | 25   |
| P205                   | 76 lb/an yr            |                               |                               | 17                               | 17   |
| K20                    | 149 lb/an yr           |                               |                               | 19                               | 19   |
| Total                  |                        | 15490                         | 246                           | 61                               | -185                                       |

TABLE A-2. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, 100 COWS

| Component              | Quantity               | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|------------------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 688 hrs                |                               | 55                            |                                  | -55  |
| Tractor                | 619 hrs                |                               | 93                            |                                  | -93  |
| Energy                 | 0 kw                   |                               | 0                             |                                  | 0  |
| Tractor scraper/loader | 1                      | 5670                          | 11                            |                                  | -11  |
| Concrete floor         | 55 ft <sup>2</sup> /an | 10611                         | 13                            |                                  | -13  |
| Box spreader/daily use | 1                      | 7980                          | 25                            |                                  | -25  |
| Nutrients              |                        |                               |                               |                                  |  |
| N                      | 124 lb/an yr           |                               |                               | 25                               | 25   |
| P205                   | 76 lb/an yr            |                               |                               | 17                               | 17   |
| K20                    | 149 lb/an yr           |                               |                               | 19                               | 19   |
| Total                  |                        | 24261                         | 196                           | 61                               | -135                                       |

TABLE A-3. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, 200 COWS

| Component               | Quantity               | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|-------------------------|------------------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                   | 1124 hrs               |                               | 45                            |                                  | -45  |
| Tractor                 | 1012 hrs               |                               | 95                            |                                  | -95  |
| Energy                  | 0 kw                   |                               | 0                             |                                  | 0  |
| Tractor scraper/loader  | 1                      | 8610                          | 8                             |                                  | -8   |
| Concrete floor          | 50 ft <sup>2</sup> /an | 19305                         | 12                            |                                  | -12  |
| Box spreader/no storage | 1                      | 10080                         | 16                            |                                  | -16  |
| Nutrients               |                        |                               |                               |                                  |  |
| N                       | 124 lb/an yr           |                               |                               | 25                               | 25   |
| P205                    | 76 lb/an yr            |                               |                               | 17                               | 17   |
| K20                     | 149 lb/an yr           |                               |                               | 19                               | 19   |
| Total                   |                        | 37995                         | 175                           | 61                               | -114                                       |

TABLE A-4. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
PLANK STORAGE, SURFACE SPREAD, 50 COWS

| Component              | Quantity               | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|------------------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 400 hrs                |                               | 64                            |                                  | -64  |
| Tractor                | 400 hrs                |                               | 120                           |                                  | -120                                       |
| Energy                 | 0 kw                   |                               | 0                             |                                  | 0  |
| Tractor scraper/loader | 1                      | 5670                          | 22                            |                                  | -22  |
| Concrete floor         | 55 ft <sup>2</sup> /an | 5305                          | 13                            |                                  | -13  |
| Storage/plank          | 4x75x75 ft             | 8437                          | 27                            |                                  | -27  |
| Box spreader/storgae   | 1                      | 4515                          | 28                            |                                  | -28  |
| Nutrients              |                        |                               |                               |                                  |  |
| N                      | 143 lb/an yr           |                               |                               | 29                               | 29   |
| P205                   | 76 lb/an yr            |                               |                               | 17                               | 17   |
| K20                    | 149 lb/an yr           |                               |                               | 19                               | 19   |
| Total                  |                        | 23927                         | 273                           | 65                               | -209                                       |

TABLE A-5. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE, PLANK STORAGE, SURFACE SPREAD, 100 COWS

| Component              | Quantity               | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|------------------------|------------------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                  | 626 hrs                |                         | 50                      |                            | -50                                  |
| Tractor                | 563 hrs                |                         | 85                      |                            | -85                                  |
| Energy                 | 0 kw                   |                         | 0                       |                            | 0                                    |
| Tractor scraper/loader | 1                      | 5670                    | 11                      |                            | -11                                  |
| Concrete floor         | 55 ft <sup>2</sup> /an | 10611                   | 13                      |                            | -13                                  |
| Storage/plank          | 4x75x150 ft            | 15444                   | 25                      |                            | -25                                  |
| Box spreader/storage   | 1                      | 7980                    | 25                      |                            | -25                                  |
| Nutrients              |                        |                         |                         |                            |                                      |
| N                      | 143 lb/an yr           |                         |                         | 29                         | 29                                   |
| P205                   | 76 lb/an yr            |                         |                         | 17                         | 17                                   |
| K20                    | 149 lb/an yr           |                         |                         | 19                         | 19                                   |
| Total                  |                        | 39705                   | 208                     | 65                         | -143                                 |

TABLE A-6. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE, PLANK STORAGE, SURFACE SPREAD, 200 COWS

| Component              | Quantity               | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|------------------------|------------------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                  | 995 hrs                |                         | 40                      |                            | -40                                  |
| Tractor                | 896 hrs                |                         | 84                      |                            | -84                                  |
| Energy                 | 0 kw                   |                         | 0                       |                            | 0                                    |
| Tractor scraper/loader | 1                      | 8610                    | 8                       |                            | -8                                   |
| Concrete floor         | 50 ft <sup>2</sup> /an | 19305                   | 12                      |                            | -12                                  |
| Storage/plank          | 4x100x225 ft           | 25740                   | 21                      |                            | -21                                  |
| Box spreader/storage   | 1                      | 10080                   | 16                      |                            | -16                                  |
| Nutrients              |                        |                         |                         |                            |                                      |
| N                      | 143 lb/an yr           |                         |                         | 29                         | 29                                   |
| P205                   | 76 lb/an yr            |                         |                         | 17                         | 17                                   |
| K20                    | 149 lb/an yr           |                         |                         | 19                         | 19                                   |
| Total                  |                        | 63735                   | 180                     | 65                         | -115                                 |

TABLE A-7. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
PIT STORAGE, SURFACE SPREAD, 50 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 407 hrs      |                               | 65                            |                                  | -65  |
| Tractor                | 366 hrs      |                               | 125                           |                                  | -125                                       |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Concrete floor         | 55 ft2/an    | 5305                          | 13                            |                                  | -13  |
| Tractor scraper/cattle | 1            | 1470                          | 6                             |                                  | -6   |
| Agitate/load pump      | 1            | 6720                          | 42                            |                                  | -42  |
| Concrete pit           |              | 14872                         | 36                            |                                  | -36  |
| Tank wagon             | 1            | 8610                          | 42                            |                                  | -42  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 116 lb/an yr |                               |                               | 23                               | 23   |
| P205                   | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                    | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                  |              | 36977                         | 328                           | 59                               | -269                                       |

TABLE A-8. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
PIT STORAGE, PLOWDOWN, 50 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 407 hrs      |                               | 65                            |                                  | -65  |
| Tractor                | 366 hrs      |                               | 125                           |                                  | -125                                       |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Concrete floor         | 55 ft2/an    | 5305                          | 13                            |                                  | -13  |
| Tractor scraper/cattle | 1            | 1470                          | 6                             |                                  | -6   |
| Agitate/load pump      | 1            | 6720                          | 42                            |                                  | -42  |
| Concrete pit           | 22500 ft3    | 14872                         | 36                            |                                  | -36  |
| Tank wagon             | 1            | 8610                          | 42                            |                                  | -42  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 149 lb/an yr |                               |                               | 30                               | 30   |
| P205                   | 80 lb/an yr  |                               |                               | 18                               | 18   |
| K20                    | 158 lb/an yr |                               |                               | 21                               | 21   |
| Total                  |              | 36977                         | 328                           | 68                               | -260                                       |



TABLE A-9. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
PIT STORAGE, SURFACE SPREAD, 100 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 626 hrs      |                               | 50                            |                                  | -50  |
| Tractor                | 563 hrs      |                               | 129                           |                                  | -129                                       |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Concrete floor         | 55 ft2/an    | 10611                         | 13                            |                                  | -13  |
| Tractor scraper/cattle | 1            | 1470                          | 3                             |                                  | -3   |
| Agitate/load pump      | 1            | 6720                          | 21                            |                                  | -21  |
| Concrete pit           | 45000 ft3    | 29744                         | 36                            |                                  | -36  |
| Tank wagon             | 1            | 11340                         | 28                            |                                  | -28  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 116 lb/an yr |                               |                               | 23                               | 23   |
| P205                   | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                    | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                  |              | 59885                         | 279                           | 59                               | -219                                       |

TABLE A-10. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
PIT STORAGE, PLOWDOWN, 100 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 626 hrs      |                               | 50                            |                                  | -50  |
| Tractor                | 563 hrs      |                               | 129                           |                                  | -129                                       |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Concrete floor         | 55 ft2/an    | 10611                         | 13                            |                                  | -13  |
| Tractor scraper/cattle | 1            | 1470                          | 3                             |                                  | -3   |
| Agitate/load pump      | 1            | 6720                          | 21                            |                                  | -21  |
| Concrete pit           | 45000 ft3    | 29744                         | 36                            |                                  | -36  |
| Tank wagon             | 1            | 11340                         | 28                            |                                  | -28  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 149 lb/an yr |                               |                               | 30                               | 30   |
| P205                   | 80 lb/an yr  |                               |                               | 18                               | 18   |
| K20                    | 158 lb/an yr |                               |                               | 21                               | 21   |
| Total                  |              | 59885                         | 279                           | 68                               | -211                                       |

TABLE A-11. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
PIT STORAGE, SURFACE SPREAD, 200 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 939 hrs      |                               | 38                            |                                  | -38  |
| Tractor                | 809 hrs      |                               | 93                            |                                  | -93  |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Concrete floor         | 55 ft2/an    | 21164                         | 13                            |                                  | -13  |
| Tractor scraper/cattle | 1            | 1470                          | 1                             |                                  | -1   |
| Agitate/load pump      | 1            | 6720                          | 10                            |                                  | -10  |
| Concrete pit           | 90000 ft3    | 59488                         | 36                            |                                  | -36  |
| Tank wagon             | 1            | 11340                         | 14                            |                                  | -14  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 116 lb/an yr |                               |                               | 23                               | 23   |
| P205                   | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                    | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                  |              | 100182                        | 204                           | 59                               | -145                                       |

TABLE A-12. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, TRACTOR SCRAPE,  
PIT STORAGE, PLOWDOWN, 200 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 939 hrs      |                               | 38                            |                                  | -38  |
| Tractor                | 809 hrs      |                               | 93                            |                                  | -93  |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Concrete floor         | 55 ft2/an    | 21221                         | 13                            |                                  | -13  |
| Tractor scraper/cattle | 1            | 1470                          | 1                             |                                  | -1   |
| Agitate/load pump      | 1            | 6720                          | 10                            |                                  | -10  |
| Concrete pit           | 90000 ft3    | 59488                         | 36                            |                                  | -36  |
| Tank wagon             | 1            | 11340                         | 14                            |                                  | -14  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 149 lb/an yr |                               |                               | 30                               | 30   |
| P205                   | 80 lb/an yr  |                               |                               | 18                               | 18   |
| K20                    | 158 lb/an yr |                               |                               | 21                               | 21   |
| Total                  |              | 100239                        | 204                           | 68                               | -136                                       |

TABLE A-13. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, SLOTTED FLOOR,  
PIT STORAGE, SURFACE SPREAD, 100 COWS

| Component         | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|-------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor             | 396 hrs      |                               | 32                            |                                  | -32  |
| Tractor           | 355 hrs      |                               | 81                            |                                  | -81  |
| Energy            | 5000 kw      |                               | 6                             |                                  | -6   |
| Agitate/load pump | 1            | 6720                          | 21                            |                                  | -21  |
| Concrete slats    | 1450 ft2     | 4576                          | 8                             |                                  | -8   |
| Concrete pit      | 33000 ft3    | 67496                         | 81                            |                                  | -81  |
| Pit ventilation   | 1            | 1155                          | 4                             |                                  | -4   |
| Tank wagon        | 1            | 11340                         | 28                            |                                  | -28  |
| Nutrients         |              |                               |                               |                                  |  |
| N                 | 116 lb/an yr |                               |                               | 23                               | 23   |
| P205              | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20               | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total             |              | 91287                         | 259                           | 59                               | -200                                       |

TABLE A-14. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, SLOTTED FLOOR  
PIT STORAGE, PLOWDOWN, 100 COWS

| Component         | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|-------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor             | 396 hrs      |                               | 32                            |                                  | -32  |
| Tractor           | 355 hrs      |                               | 81                            |                                  | -81  |
| Energy            | 5000 kw      |                               | 6                             |                                  | -6   |
| Agitate/load pump | 1            | 6720                          | 21                            |                                  | -21  |
| Concrete slats    | 1450 ft2     | 4576                          | 8                             |                                  | -8   |
| Concrete pit      | 33000 ft3    | 67496                         | 81                            |                                  | -81  |
| Pit ventilation   | 1            | 1155                          | 4                             |                                  | -4   |
| Tank wagon        | 1            | 11340                         | 28                            |                                  | -28  |
| Nutrients         |              |                               |                               |                                  |  |
| N                 | 149 lb/an yr |                               |                               | 30                               | 30   |
| P205              | 80 lb/an yr  |                               |                               | 18                               | 18   |
| K20               | 158 lb/an yr |                               |                               | 21                               | 21   |
| Total             |              | 91287                         | 259                           | 68                               | -191                                       |

TABLE A-15. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE,  
PISTON PUMP, EARTHEN STORAGE, SURFACE SPREAD, 50 COWS

| Component          | Quantity               | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|--------------------|------------------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor              | 268 hrs                |                               | 43                            |                                  | -43  |
| Tractor            | 288 hrs                |                               | 153                           |                                  | -153                                       |
| Energy             | 300 kw                 |                               | 1                             |                                  | -1   |
| Alleyway scraper   | 1                      | 9387                          | 47                            |                                  | -47  |
| Piston pump/hollow | 1                      | 6300                          | 31                            |                                  | -31  |
| Agitate/load pump  | 1                      | 6720                          | 42                            |                                  | -42  |
| Storage basin      | 37000 ft <sup>3</sup>  | 7293                          | 19                            |                                  | -19  |
| Concrete floor     | 55 ft <sup>2</sup> /an | 5305                          | 13                            |                                  | -13  |
| Tank wagon         | 1                      | 8610                          | 42                            |                                  | -42  |
| Nutrients          |                        |                               |                               |                                  |  |
| N                  | 116 lb/an yr           |                               |                               | 23                               | 23   |
| P205               | 76 lb/an yr            |                               |                               | 17                               | 17   |
| K20                | 149 lb/an yr           |                               |                               | 19                               | 19   |
| Total              |                        | 43615                         | 390                           | 59                               | -331                                       |

TABLE A-16. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE,  
PISTON PUMP, EARTHEN STORAGE, PLOWDOWN, 50 COWS

| Component          | Quantity               | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|--------------------|------------------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor              | 268 hrs                |                               | 43                            |                                  | -43  |
| Tractor            | 288 hrs                |                               | 153                           |                                  | -153                                       |
| Energy             | 300 kw                 |                               | 1                             |                                  | -1   |
| Alleyway scraper   | 1                      | 9387                          | 47                            |                                  | -47  |
| Piston pump/hollow | 1                      | 6300                          | 31                            |                                  | -31  |
| Agitate/load pump  | 1                      | 6720                          | 42                            |                                  | -42  |
| Storage basin      | 37000 ft <sup>3</sup>  | 7293                          | 19                            |                                  | -19  |
| Concrete floor     | 55 ft <sup>2</sup> /an | 5305                          | 13                            |                                  | -13  |
| Tank wagon         | 1                      | 8610                          | 42                            |                                  | -42  |
| Nutrients          |                        |                               |                               |                                  |  |
| N                  | 149 lb/an yr           |                               |                               | 30                               | 30   |
| P205               | 80 lb/an yr            |                               |                               | 18                               | 18   |
| K20                | 158 lb/an yr           |                               |                               | 21                               | 21   |
| Total              |                        | 43615                         | 390                           | 68                               | -322                                       |

TABLE A-17. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE,  
PISTON PUMP, EARTHEN STORAGE, SURFACE SPREAD, 100 COWS

| Component          | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|--------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor              | 408 hrs      |                               | 33                            |                                  | -33  |
| Tractor            | 445 hrs      |                               | 119                           |                                  | -119                                       |
| Energy             | 600 kw       |                               | 1                             |                                  | -1   |
| Alleyway scraper   | 1            | 10437                         | 26                            |                                  | -26  |
| Piston pump/hollow | 1            | 7980                          | 19                            |                                  | -19  |
| Agitate/load pump  | 1            | 6720                          | 21                            |                                  | -21  |
| Storage basin      | 73000 ft3    | 13013                         | 17                            |                                  | -17  |
| Concrete floor     | 55 ft2/an    | 10611                         | 13                            |                                  | -13  |
| Tank wagon         | 1            | 11340                         | 28                            |                                  | -28  |
| Nutrients          |              |                               |                               |                                  |  |
| N                  | 116 lb/an yr |                               |                               | 23                               | 23   |
| P205               | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total              |              | 60101                         | 276                           | 59                               | -216                                       |

TABLE A-18. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE,  
PISTON PUMP, EARTHEN STORAGE, PLOWDOWN, 100 COWS

| Component          | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|--------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor              | 408 hrs      |                               | 33                            |                                  | -33  |
| Tractor            | 445 hrs      |                               | 119                           |                                  | -119                                       |
| Energy             | 600 kw       |                               | 1                             |                                  | -1   |
| Alleyway scraper   | 1            | 10437                         | 26                            |                                  | -26  |
| Piston pump/hollow | 1            | 7980                          | 19                            |                                  | -19  |
| Agitate/load pump  | 1            | 6720                          | 21                            |                                  | -21  |
| Storage basin      | 73000 ft3    | 13013                         | 17                            |                                  | -17  |
| Concrete floor     | 55 ft2/an    | 10611                         | 13                            |                                  | -13  |
| Tank wagon         | 1            | 11340                         | 28                            |                                  | -28  |
| Nutrients          |              |                               |                               |                                  |  |
| N                  | 149 lb/an yr |                               |                               | 30                               | 30   |
| P205               | 80 lb/an yr  |                               |                               | 18                               | 18   |
| K20                | 158 lb/an yr |                               |                               | 21                               | 21   |
| Total              |              | 60101                         | 276                           | 68                               | -208                                       |

TABLE A-19. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE, PISTON PUMP, EARTHEN STORAGE, SURFACE SPREAD, 200 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 650 hrs      |                         | 26                      |                            | -26                                  |
| Tractor            | 740 hrs      |                         | 85                      |                            | -85                                  |
| Energy             | 900 kw       |                         | 1                       |                            | -1                                   |
| Alleyway scraper   | 1            | 12705                   | 16                      |                            | -16                                  |
| Piston pump/hollow | 1            | 7980                    | 10                      |                            | -10                                  |
| Agitate/load pump  | 1            | 6720                    | 10                      |                            | -10                                  |
| Storage basin      | 146000 ft3   | 23738                   | 15                      |                            | -15                                  |
| Concrete floor     | 55 ft2/an    | 21221                   | 13                      |                            | -13                                  |
| Tank wagon         | 1            | 14700                   | 18                      |                            | -18                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 116 lb/an yr |                         |                         | 23                         | 23                                   |
| P205               | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total              |              | 87064                   | 193                     | 59                         | -134                                 |

TABLE A-20. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE, PISTON PUMP, EARTHEN STORAGE, PLOWDOWN, 200 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 650 hrs      |                         | 26                      |                            | -26                                  |
| Tractor            | 740 hrs      |                         | 85                      |                            | -85                                  |
| Energy             | 900 kw       |                         | 1                       |                            | -1                                   |
| Alleyway scraper   | 1            | 12705                   | 16                      |                            | -16                                  |
| Piston pump/hollow | 1            | 7980                    | 10                      |                            | -10                                  |
| Agitate/load pump  | 1            | 6720                    | 10                      |                            | -10                                  |
| Storage basin      | 146000 ft3   | 23738                   | 15                      |                            | -15                                  |
| Concrete floor     | 55 ft2/an    | 21221                   | 13                      |                            | -13                                  |
| Tank wagon         | 1            | 14700                   | 18                      |                            | -18                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 149 lb/an yr |                         |                         | 30                         | 30                                   |
| P205               | 80 lb/an yr  |                         |                         | 18                         | 18                                   |
| K20                | 158 lb/an yr |                         |                         | 21                         | 21                                   |
| Total              |              | 87064                   | 193                     | 68                         | -126                                 |

TABLE A-21. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE,  
PISTON PUMP, SILO STORAGE, SURFACE SPREAD, 100 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 408 hrs      |                         | 33                      |                            | -33                                  |
| Tractor            | 445 hrs      |                         | 79                      |                            | -79                                  |
| Energy             | 600 kw       |                         | 1                       |                            | -1                                   |
| Alleyway scraper   | 1            | 10437                   | 26                      |                            | -26                                  |
| Piston pump/hollow | 1            | 7980                    | 19                      |                            | -19                                  |
| Agitate/load pump  | 1            | 6720                    | 21                      |                            | -21                                  |
| Above ground tank  | 18000 ft3    | 23595                   | 28                      |                            | -28                                  |
| Concrete floor     | 55 ft2/an    | 10611                   | 13                      |                            | -13                                  |
| Tank wagon         | 1            | 11340                   | 28                      |                            | -28                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 116 lb/an yr |                         |                         | 23                         | 23                                   |
| P205               | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total              |              | 70683                   | 248                     | 59                         | -188                                 |

TABLE A-22. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE,  
PISTON PUMP, SILO STORAGE, PLOWDOWN, 100 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 408 hrs      |                         | 33                      |                            | -33                                  |
| Tractor            | 445 hrs      |                         | 79                      |                            | -79                                  |
| Energy             | 600 kw       |                         | 1                       |                            | -1                                   |
| Alleyway scraper   | 1            | 10437                   | 26                      |                            | -26                                  |
| Piston pump/hollow | 1            | 7980                    | 19                      |                            | -19                                  |
| Agitate/load pump  | 1            | 6720                    | 21                      |                            | -21                                  |
| Above ground tank  | 18000 ft3    | 23595                   | 28                      |                            | -28                                  |
| Concrete floor     | 55 ft2/an    | 10611                   | 13                      |                            | -13                                  |
| Tank wagon         | 1            | 11340                   | 28                      |                            | -28                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 149 lb/an yr |                         |                         | 30                         | 30                                   |
| P205               | 80 lb/an yr  |                         |                         | 18                         | 18                                   |
| K20                | 158 lb/an yr |                         |                         | 21                         | 21                                   |
| Total              |              | 70683                   | 248                     | 68                         | -180                                 |

TABLE A-23. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE, PIT STORAGE, SURFACE SPREAD, 100 COWS

| Component         | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor             | 408 hrs      |                         | 33                      |                            | -33                                  |
| Tractor           | 345 hrs      |                         | 79                      |                            | -79                                  |
| Energy            | 32000 kw     |                         | 36                      |                            | -36                                  |
| Alleyway scraper  | 1            | 10437                   | 26                      |                            | -26                                  |
| Concrete floor    | 55 ft2/an    | 10611                   | 13                      |                            | -13                                  |
| Agitate/load pump | 1            | 6720                    | 21                      |                            | -21                                  |
| Concrete pit      | 33000 ft3    | 67496                   | 81                      |                            | -81                                  |
| Pit ventilation   | 1            | 1155                    | 4                       |                            | -4                                   |
| Tank wagon        | 1            | 11340                   | 28                      |                            | -28                                  |
| Nutrients         |              |                         |                         |                            |                                      |
| N                 | 116 lb/an yr |                         |                         | 23                         | 23                                   |
| P205              | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20               | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total             |              | 107759                  | 319                     | 59                         | -260                                 |

TABLE A-24. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, MECHANICAL SCRAPE, PIT STORAGE, PLOWDOWN, 100 COWS

| Component         | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor             | 408 hrs      |                         | 33                      |                            | -33                                  |
| Tractor           | 345 hrs      |                         | 79                      |                            | -79                                  |
| Energy            | 32000 kw     |                         | 36                      |                            | -36                                  |
| Alleyway scraper  | 1            | 10437                   | 26                      |                            | -26                                  |
| Concrete floor    | 55 ft2/an    | 10611                   | 13                      |                            | -13                                  |
| Agitate/load pump | 1            | 6720                    | 21                      |                            | -21                                  |
| Concrete pit      | 33000 ft3    | 67496                   | 81                      |                            | -81                                  |
| Pit ventilation   | 1            | 1155                    | 4                       |                            | -4                                   |
| Tank wagon        | 1            | 11340                   | 28                      |                            | -28                                  |
| Nutrients         |              |                         |                         |                            |                                      |
| N                 | 149 lb/an yr |                         |                         | 30                         | 30                                   |
| P205              | 80 lb/an yr  |                         |                         | 18                         | 18                                   |
| K20               | 158 lb/an yr |                         |                         | 21                         | 21                                   |
| Total             |              | 107759                  | 319                     | 68                         | -251                                 |



TABLE A-25. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER,  
DAILY SPREAD, 50 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 275 hrs      |                               | 44                            |                                  | -44  |
| Tractor                | 248 hrs      |                               | 85                            |                                  | -85  |
| Energy                 | 240 kw       |                               | 1                             |                                  | -1   |
| Concrete floor/gutter  | 1            | 8044                          | 19                            |                                  | -19  |
| Gutter cleaner         | 1            | 7392                          | 31                            |                                  | -31  |
| Box spreader/daily use | 1            | 4515                          | 28                            |                                  | -28  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 124 lb/an yr |                               |                               | 25                               | 25   |
| P2O5                   | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K2O                    | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                  |              | 19951                         | 208                           | 61                               | -147                                       |

TABLE A-26. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER,  
DAILY SPREAD, 100 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 477 hrs      |                               | 38                            |                                  | -38  |
| Tractor                | 365 hrs      |                               | 90                            |                                  | -90  |
| Energy                 | 410 kw       |                               | 0                             |                                  | 0  |
| Concrete floor/gutter  | 1            | 16088                         | 19                            |                                  | -19  |
| Gutter cleaner         | 1            | 11550                         | 24                            |                                  | -24  |
| Box spreader/daily use | 1            | 7980                          | 25                            |                                  | -25  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 124 lb/an yr |                               |                               | 25                               | 25   |
| P2O5                   | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K2O                    | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                  |              | 35618                         | 196                           | 61                               | -136                                       |

TABLE A-27. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER, PISTON PUMP, CONCRETE STORAGE, SURFACE SPREAD, 50 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 228 hrs      |                         | 36                      |                            | -36                                  |
| Tractor                   | 207 hrs      |                         | 71                      |                            | -71                                  |
| Energy                    | 1180 kw      |                         | 3                       |                            | -3                                   |
| Concrete floor/gutter     | 1            | 8044                    | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 7392                    | 31                      |                            | -31                                  |
| Covered concrete/storage  | 18000 ft3    | 17732                   | 43                      |                            | -43                                  |
| Piston pump/solid hd      | 1            | 20160                   | 98                      |                            | -98                                  |
| Box spreader/periodic use | 1            | 4515                    | 19                      |                            | -19                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 143 lb/an yr |                         |                         | 29                         | 29                                   |
| P205                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                       | 141 lb/an yr |                         |                         | 18                         | 18                                   |
| Total                     |              | 57843                   | 320                     | 64                         | -256                                 |

TABLE A-28. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER, PISTON PUMP, CONCRETE STORAGE, PLOWDOWN, 50 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 228 hrs      |                         | 36                      |                            | -36                                  |
| Tractor                   | 207 hrs      |                         | 71                      |                            | -71                                  |
| Energy                    | 1180 kw      |                         | 3                       |                            | -3                                   |
| Concrete floor/gutter     | 1            | 8044                    | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 7392                    | 31                      |                            | -31                                  |
| Covered concrete/storage  | 18000 ft3    | 17732                   | 43                      |                            | -43                                  |
| Piston pump/solid hd      | 1            | 20160                   | 98                      |                            | -98                                  |
| Box spreader/periodic use | 1            | 4515                    | 19                      |                            | -19                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 179 lb/an yr |                         |                         | 36                         | 36                                   |
| P205                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                       | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total                     |              | 57843                   | 320                     | 72                         | -248                                 |

TABLE A-29. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER,  
PISTON PUMP, CONCRETE STORAGE, SURFACE SPREAD, 100 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 329 hrs      |                         | 26                      |                            | -26                                  |
| Tractor                   | 105 hrs      |                         | 21                      |                            | -21                                  |
| Energy                    | 1760 kw      |                         | 2                       |                            | -2                                   |
| Concrete floor/gutter     | 1            | 16088                   | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 11550                   | 24                      |                            | -24                                  |
| Covered concrete/storage  | 36000 ft3    | 32175                   | 39                      |                            | -39                                  |
| Piston pump/solid hd      | 1            | 20160                   | 49                      |                            | -49                                  |
| Box spreader/periodic use | 1            | 7980                    | 17                      |                            | -17                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 143 lb/an yr |                         |                         | 29                         | 29                                   |
| P205                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                       | 141 lb/an yr |                         |                         | 18                         | 18                                   |
| Total                     |              | 87953                   | 198                     | 64                         | -134                                 |

TABLE A-30. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER,  
PISTON PUMP, CONCRETE STORAGE, PLOWDOWN, 100 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 329 hrs      |                         | 26                      |                            | -26                                  |
| Tractor                   | 105 hrs      |                         | 21                      |                            | -21                                  |
| Energy                    | 1760 kw      |                         | 2                       |                            | -2                                   |
| Concrete floor/gutter     | 1            | 16088                   | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 11550                   | 24                      |                            | -24                                  |
| Covered concrete/storage  | 36000 ft3    | 32175                   | 39                      |                            | -39                                  |
| Piston pump/solid hd      | 1            | 20160                   | 49                      |                            | -49                                  |
| Box spreader/periodic use | 1            | 7980                    | 17                      |                            | -17                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 179 lb/an yr |                         |                         | 36                         | 36                                   |
| P205                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                       | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total                     |              | 87953                   | 198                     | 72                         | -126                                 |

TABLE A-31. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER, STACKER, PLANK STORAGE, SURFACE SPREAD, 50 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 228 hrs      |                         | 36                      |                            | -36                                  |
| Tractor                   | 207 hrs      |                         | 71                      |                            | -71                                  |
| Energy                    | 480 kw       |                         | 1                       |                            | -1                                   |
| Concrete floor/gutter     | 1            | 8044                    | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 7392                    | 31                      |                            | -31                                  |
| Stacker                   | 1            | 7266                    | 31                      |                            | -31                                  |
| Storage/plank             | 4x75x75 ft   | 9896                    | 32                      |                            | -32                                  |
| Box spreader/periodic use | 1            | 4515                    | 19                      |                            | -19                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 143 lb/an yr |                         |                         | 29                         | 29                                   |
| P2O5                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K2O                       | 141 lb/an yr |                         |                         | 18                         | 18                                   |
| Total                     |              | 37112                   | 240                     | 64                         | -176                                 |

TABLE A-32. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER, STACKER, PLANK STORAGE, PLOWDOWN, 50 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 228 hrs      |                         | 36                      |                            | -36                                  |
| Tractor                   | 207 hrs      |                         | 71                      |                            | -71                                  |
| Energy                    | 480 kw       |                         | 1                       |                            | -1                                   |
| Concrete floor/gutter     | 1            | 8044                    | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 7392                    | 31                      |                            | -31                                  |
| Stacker                   | 1            | 7266                    | 31                      |                            | -31                                  |
| Storage/plank             | 4x75x75 ft   | 9896                    | 32                      |                            | -32                                  |
| Box spreader/periodic use | 1            | 4515                    | 19                      |                            | -19                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 170 lb/an yr |                         |                         | 34                         | 34                                   |
| P2O5                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K2O                       | 141 lb/an yr |                         |                         | 18                         | 18                                   |
| Total                     |              | 37112                   | 240                     | 69                         | -171                                 |

TABLE A-33. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER, STACKER, PLANK STORAGE, SURFACE SPREAD, 100 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 417 hrs      |                         | 67                      |                            | -67                                  |
| Tractor                   | 378 hrs      |                         | 65                      |                            | -65                                  |
| Energy                    | 1200 kw      |                         | 1                       |                            | -1                                   |
| Concrete floor/gutter     | 1            | 16088                   | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 11550                   | 24                      |                            | -24                                  |
| Stacker                   | 1            | 9744                    | 20                      |                            | -20                                  |
| Storage/plank             | 1            | 15444                   | 25                      |                            | -25                                  |
| Box spreader/periodic use | 1            | 9660                    | 20                      |                            | -20                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 143 lb/an yr |                         |                         | 29                         | 29                                   |
| P205                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                       | 141 lb/an yr |                         |                         | 18                         | 18                                   |
| Total                     |              | 62486                   | 242                     | 64                         | -178                                 |

TABLE A-34. ECONOMIC DATA FOR DAIRY, CONFINEMENT STALL, GUTTER CLEANER, STACKER, PLANK STORAGE, PLOWDOWN, 100 COWS

| Component                 | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|---------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                     | 417 hrs      |                         | 67                      |                            | -67                                  |
| Tractor                   | 378 hrs      |                         | 65                      |                            | -65                                  |
| Energy                    | 1200 kw      |                         | 1                       |                            | -1                                   |
| Concrete floor/gutter     | 1            | 16088                   | 19                      |                            | -19                                  |
| Gutter cleaner            | 1            | 11550                   | 24                      |                            | -24                                  |
| Stacker                   | 1            | 9744                    | 20                      |                            | -20                                  |
| Storage/plank             | 1            | 15444                   | 25                      |                            | -25                                  |
| Box spreader/periodic use | 1            | 9660                    | 20                      |                            | -20                                  |
| Nutrients                 |              |                         |                         |                            |                                      |
| N                         | 170 lb/an yr |                         |                         | 34                         | 34                                   |
| P205                      | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                       | 141 lb/an yr |                         |                         | 18                         | 18                                   |
| Total                     |              | 62486                   | 242                     | 69                         | -173                                 |

TABLE A-35. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, 50 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 314 hrs      |                               | 50                            |                                  | -50  |
| Tractor                | 314 hrs      |                               | 81                            |                                  | -81  |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Tractor scraper/loader | 1            | 5670                          | 22                            |                                  | -22  |
| Concrete lot           | 85 ft2/an    | 5792                          | 14                            |                                  | -14  |
| Box spreader/daily use | 1            | 4515                          | 28                            |                                  | -28  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 124 lb/an yr |                               |                               | 25                               | 25   |
| P205                   | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                    | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                  |              | 15977                         | 195                           | 61                               | -134                                       |

TABLE A-36. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, DIVERSION, SETTLING BASIN, GRASS  
INFILTRATION AREA, 50 COWS

| Component               | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|-------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                   | 314 hrs      |                               | 50                            |                                  | -50  |
| Tractor                 | 314 hrs      |                               | 82                            |                                  | -82  |
| Energy                  | 0 kw         |                               | 0                             |                                  | 0  |
| Tractor scraper/loader  | 1            | 5670                          | 22                            |                                  | -22  |
| Concrete lot            | 85 ft2/an    | 5792                          | 14                            |                                  | -14  |
| Box spreader/daily use  | 1            | 4515                          | 28                            |                                  | -28  |
| Diversion Terrace       | 200 ft       | 72                            | 0                             |                                  | 0  |
| Settling basin/concrete | 200 ft2      | 386                           | 1                             |                                  | -1   |
| Infiltration area       | 10x120 ft    | 137                           | 0                             |                                  | 0  |
| Nutrients               |              |                               |                               |                                  |  |
| N                       | 124 lb/an yr |                               |                               | 25                               | 25   |
| P205                    | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                     | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                   |              | 16571                         | 197                           | 61                               | -136                                       |

TABLE A-37. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, DIVERSION, SETTLING BASIN, DETENTION BASIN  
WASTE WATER IRRIGATION, 50 COWS

| Component                | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|--------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                    | 332 hrs      |                               | 53                            |                                  | -53  |
| Tractor                  | 315 hrs      |                               | 81                            |                                  | -81  |
| Energy                   | 400 kw       |                               | 1                             |                                  | -1   |
| Tractor scraper/loader   | 1            | 5670                          | 22                            |                                  | -22  |
| Concrete lot             | 85 ft2/an    | 5792                          | 14                            |                                  | -14  |
| Box spreader/daily use   | 1            | 4515                          | 28                            |                                  | -28  |
| Diversion Terrace        | 200 ft       | 72                            | 0                             |                                  | 0  |
| Settling basin/concrete  | 200 ft2      | 386                           | 1                             |                                  | -1   |
| Detention basin          | 5400 ft3     | 465                           | 1                             |                                  | -1   |
| Wastewater irrigation/RO | 1            | 3098                          | 16                            |                                  | -16  |
| Nutrients                |              |                               |                               |                                  |  |
| N                        | 124 lb/an yr |                               |                               | 25                               | 25   |
| P2O5                     | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K2O                      | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                    |              | 19996                         | 217                           | 61                               | -156                                       |

TABLE A-38. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, 100 COWS

| Component              | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                  | 507 hrs      |                               | 41                            |                                  | -41  |
| Tractor                | 507 hrs      |                               | 76                            |                                  | -76  |
| Energy                 | 0 kw         |                               | 0                             |                                  | 0  |
| Tractor scraper/loader | 1            | 5670                          | 11                            |                                  | -11  |
| Concrete lot           | 85 ft2/an    | 11583                         | 14                            |                                  | -14  |
| Box spreader/daily use | 1            | 7980                          | 25                            |                                  | -25  |
| Nutrients              |              |                               |                               |                                  |  |
| N                      | 124 lb/an yr |                               |                               | 25                               | 25   |
| P2O5                   | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K2O                    | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                  |              | 25233                         | 166                           | 61                               | -105                                       |

TABLE A-39. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, DIVERSION, SETTLING BASIN, GRASS  
INFILTRATION AREA, 100 COWS

| Component               | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|-------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                   | 512 hrs      |                               | 41                            |                                  | -41  |
| Tractor                 | 510 hrs      |                               | 77                            |                                  | -77  |
| Energy                  | 0 kw         |                               | 0                             |                                  | 0  |
| Tractor scraper/loader  | 1            | 5670                          | 11                            |                                  | -11  |
| Concrete lot            | 85 ft2/an    | 11583                         | 14                            |                                  | -14  |
| Box spreader/daily use  | 1            | 7980                          | 25                            |                                  | -25  |
| Diversion Terrace       | 300 ft       | 107                           | 0                             |                                  | 0  |
| Settling basin/concrete | 360 ft2      | 696                           | 1                             |                                  | -1   |
| Infiltration area       | 10x140 ft    | 157                           | 0                             |                                  | 0  |
| Nutrients               |              |                               |                               |                                  |  |
| N                       | 124 lb/an yr |                               |                               | 25                               | 25   |
| P205                    | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                     | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                   |              | 26194                         | 168                           | 61                               | -107                                       |

TABLE A-40. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, DIVERSION, SETTLING BASIN, DETENTION BASIN  
WASTE WATER IRRIGATION, 100 COWS

| Component                | Quantity     | Capital<br>Investment<br>(\$) | Annual<br>Cost<br>(\$/cow yr) | Annual<br>Returns<br>(\$/cow yr) | Annual Net<br>System Return<br>(\$/cow yr) |
|--------------------------|--------------|-------------------------------|-------------------------------|----------------------------------|--|
| Labor                    | 525 hrs      |                               | 42                            |                                  | -42  |
| Tractor                  | 508 hrs      |                               | 76                            |                                  | -76  |
| Energy                   | 800 kw       |                               | 1                             |                                  | -1   |
| Tractor scraper/loader   | 1            | 5670                          | 11                            |                                  | -11  |
| Concrete lot             | 85 ft2/an    | 11583                         | 14                            |                                  | -14  |
| Box spreader/daily use   | 1            | 7980                          | 25                            |                                  | -25  |
| Diversion Terrace        | 300 ft       | 107                           | 0                             |                                  | 0  |
| Settling basin/concrete  | 360 ft2      | 696                           | 1                             |                                  | -1   |
| Detention basin          | 10000 ft3    | 868                           | 1                             |                                  | -1   |
| Wastewater irrigation/RO | 1            | 3263                          | 8                             |                                  | -8   |
| Nutrients                |              |                               |                               |                                  |  |
| N                        | 124 lb/an yr |                               |                               | 25                               | 25   |
| P205                     | 76 lb/an yr  |                               |                               | 17                               | 17   |
| K20                      | 149 lb/an yr |                               |                               | 19                               | 19   |
| Total                    |              | 30168                         | 179                           | 61                               | -118                                       |



TABLE A-41. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, 200 COWS

| Component              | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                  | 667 hrs      |                         | 27                      |                            | -27                                  |
| Tractor                | 667 hrs      |                         | 56                      |                            | -56                                  |
| Energy                 | 0 kw         |                         | 0                       |                            | 0                                    |
| Tractor scraper/loader | 1            | 5670                    | 5                       |                            | -5                                   |
| Concrete lot           | 85 ft2/an    | 23166                   | 14                      |                            | -14                                  |
| Box spreader/daily use | 1            | 10080                   | 16                      |                            | -16                                  |
| Nutrients              |              |                         |                         |                            |                                      |
| N                      | 124 lb/an yr |                         |                         | 25                         | 25                                   |
| P205                   | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                    | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total                  |              | 38916                   | 118                     | 61                         | -57                                  |

TABLE A-42. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, DIVERSION, SETTLING BASIN, GRASS  
INFILTRATION AREA, 200 COWS

| Component               | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 673 hrs      |                         | 27                      |                            | -27                                  |
| Tractor                 | 669 hrs      |                         | 56                      |                            | -56                                  |
| Energy                  | 0 kw         |                         | 0                       |                            | 0                                    |
| Tractor scraper/loader  | 1            | 5670                    | 5                       |                            | -5                                   |
| Concrete lot            | 85 ft2/an    | 23166                   | 14                      |                            | -14                                  |
| Box spreader/daily use  | 1            | 10080                   | 16                      |                            | -16                                  |
| Diversion Terrace       | 400 ft       | 143                     | 0                       |                            | 0                                    |
| Settling basin/concrete | 850 ft2      | 2388                    | 1                       |                            | -1                                   |
| Infiltration area       | 8x200 ft     | 183                     | 0                       |                            | 0                                    |
| Nutrients               |              |                         |                         |                            |                                      |
| N                       | 124 lb/an yr |                         |                         | 25                         | 25                                   |
| P205                    | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                     | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total                   |              | 41630                   | 120                     | 61                         | -59                                  |

TABLE A-43. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
DAILY SURFACE SPREAD, DIVERSION, SETTLING BASIN, DETENTION BASIN  
WASTE WATER IRRIGATION, 200 COWS

| Component                | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                    | 703 hrs      |                         | 28                      |                            | -28                                  |
| Tractor                  | 671 hrs      |                         | 57                      |                            | -57                                  |
| Energy                   | 1600 kw      |                         | 1                       |                            | -1                                   |
| Tractor scraper/loader   | 1            | 5670                    | 5                       |                            | -5                                   |
| Concrete lot             | 85 ft2/an    | 23166                   | 14                      |                            | -14                                  |
| Box spreader/daily use   | 1            | 10080                   | 16                      |                            | -16                                  |
| Diversion Terrace        | 400 ft       | 143                     | 0                       |                            | 0                                    |
| Settling basin/concrete  | 850 ft2      | 2388                    | 1                       |                            | -1                                   |
| Detention basin          | 8700 ft3     | 744                     | 0                       |                            | 0                                    |
| Wastewater irrigation/RO | 1            | 3591                    | 5                       |                            | -5                                   |
| Nutrients                |              |                         |                         |                            |                                      |
| N                        | 124 lb/an yr |                         |                         | 25                         | 25                                   |
| P205                     | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                      | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total                    |              | 45782                   | 127                     | 61                         | -66                                  |

TABLE A-44. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE,  
PISTON PUMP, EARTHEN STORAGE, SURFACE SPREAD, 100 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 453 hrs      |                         | 36                      |                            | -36                                  |
| Tractor            | 490 hrs      |                         | 112                     |                            | -112                                 |
| Energy             | 0 kw         |                         | 0                       |                            | 0                                    |
| Alleyway scraper   | 1            | 1470                    | 4                       |                            | -4                                   |
| Piston pump/hollow | 1            | 7980                    | 19                      |                            | -19                                  |
| Concrete lot       | 85 ft2/an    | 16088                   | 19                      |                            | -19                                  |
| Agitate/load pump  | 1            | 6720                    | 21                      |                            | -21                                  |
| Tank wagon         | 1            | 11340                   | 28                      |                            | -28                                  |
| Storage basin      | 73000 ft3    | 13013                   | 17                      |                            | -17                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 116 lb/an yr |                         |                         | 23                         | 23                                   |
| P205               | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total              |              | 56611                   | 256                     | 59                         | -197                                 |

TABLE A-45. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE, PISTON PUMP, EARTHEN STORAGE, PLOWDOWN, 100 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 453 hrs      |                         | 36                      |                            | -36                                  |
| Tractor            | 490 hrs      |                         | 112                     |                            | -112                                 |
| Energy             | 0 kw         |                         | 0                       |                            | 0                                    |
| Alleyway scraper   | 1            | 1470                    | 4                       |                            | -4                                   |
| Piston pump/hollow | 1            | 7980                    | 19                      |                            | -19                                  |
| Concrete lot       | 85 ft2/an    | 16088                   | 19                      |                            | -19                                  |
| Agitate/load pump  | 1            | 6720                    | 21                      |                            | -21                                  |
| Tank wagon         | 1            | 11340                   | 28                      |                            | -28                                  |
| Storage basin      | 73000 ft3    | 13013                   | 17                      |                            | -17                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 149 lb/an yr |                         |                         | 30                         | 30                                   |
| P205               | 80 lb/an yr  |                         |                         | 18                         | 18                                   |
| K20                | 158 lb/an yr |                         |                         | 21                         | 21                                   |
| Total              |              | 56611                   | 256                     | 68                         | -188                                 |

TABLE A-46. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE, PISTON PUMP, EARTHEN STORAGE, SURFACE SPREAD, 200 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 730 hrs      |                         | 29                      |                            | -29                                  |
| Tractor            | 820 hrs      |                         | 94                      |                            | -94                                  |
| Energy             | 0 kw         |                         | 0                       |                            | 0                                    |
| Alleyway scraper   | 1            | 1470                    | 2                       |                            | -2                                   |
| Piston pump/hollow | 1            | 7980                    | 10                      |                            | -10                                  |
| Concrete lot       | 85 ft2/an    | 32175                   | 19                      |                            | -19                                  |
| Agitate/load pump  | 1            | 6720                    | 10                      |                            | -10                                  |
| Tank wagon         | 1            | 14700                   | 18                      |                            | -18                                  |
| Storage basin      | 146000 ft3   | 23738                   | 15                      |                            | -15                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 116 lb/an yr |                         |                         | 23                         | 23                                   |
| P205               | 76 lb/an yr  |                         |                         | 17                         | 17                                   |
| K20                | 149 lb/an yr |                         |                         | 19                         | 19                                   |
| Total              |              | 86783                   | 198                     | 59                         | -138                                 |

TABLE A-47. ECONOMIC DATA FOR DAIRY, FREE STALL, OPEN LOT, TRACTOR SCRAPE, PISTON PUMP, EARTHEN STORAGE, PLOWDOWN, 200 COWS

| Component          | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|--------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor              | 730 hrs      |                         | 29                      |                            | -29                                  |
| Tractor            | 820 hrs      |                         | 94                      |                            | -94                                  |
| Energy             | 0 kw         |                         | 0                       |                            | 0                                    |
| Alleyway scraper   | 1            | 1470                    | 2                       |                            | -2                                   |
| Piston pump/hollow | 1            | 7980                    | 10                      |                            | -10                                  |
| Concrete lot       | 85 ft2/an    | 32175                   | 19                      |                            | -19                                  |
| Agitate/load pump  | 1            | 6720                    | 10                      |                            | -10                                  |
| Tank wagon         | 1            | 14700                   | 18                      |                            | -18                                  |
| Storage basin      | 146000 ft3   | 23738                   | 15                      |                            | -15                                  |
| Nutrients          |              |                         |                         |                            |                                      |
| N                  | 149 lb/an yr |                         |                         | 30                         | 30                                   |
| P205               | 80 lb/an yr  |                         |                         | 18                         | 18                                   |
| K20                | 158 lb/an yr |                         |                         | 21                         | 21                                   |
| Total              |              | 86783                   | 198                     | 68                         | -130                                 |

TABLE A-48. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, FLUSH, LAGOON, WASTEWATER IRRIGATION, 200 COWS

| Component               | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 65 hrs       |                         | 3                       |                            | -3                                   |
| Tractor                 | 40 hrs       |                         | 9                       |                            | -9                                   |
| Energy                  | 2200 kw      |                         | 1                       |                            | -1                                   |
| Concrete floor          | 90 ft2/an    | 28028                   | 17                      |                            | -17                                  |
| Gated tank              | 2 @ 2000 gal | 5460                    | 6                       |                            | -6                                   |
| Lagoons                 | 575000 ft3   | 16416                   | 11                      |                            | -11                                  |
| Recycle pump            | 1            | 1103                    | 2                       |                            | -2                                   |
| Wastewater irrigation/M | 1            | 14721                   | 19                      |                            | -19                                  |
| Nutrients               |              |                         |                         |                            |                                      |
| N                       | 32 lb/an yr  |                         |                         | 6                          | 6                                    |
| P205                    | 42 lb/an yr  |                         |                         | 9                          | 9                                    |
| K20                     | 100 lb/an yr |                         |                         | 13                         | 13                                   |
| Total                   |              | 65728                   | 67                      | 29                         | -38                                  |

TABLE A-49. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, FLUSH, LAGOON, WASTEWATER IRRIGATION, 500 COWS

| Component               | Quantity                | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|-------------------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 140 hrs                 |                         | 2                       |                            | -2                                   |
| Tractor                 | 100 hrs                 |                         | 5                       |                            | -5                                   |
| Energy                  | 5500 kw                 |                         | 1                       |                            | -1                                   |
| Concrete floor          | 90 ft <sup>2</sup> /an  | 66495                   | 16                      |                            | -16                                  |
| Gated tank              | 4 @ 2000 gal            | 10920                   | 5                       |                            | -5                                   |
| Lagoons                 | 1400000 ft <sup>3</sup> | 41041                   | 11                      |                            | -11                                  |
| Recycle pump            | 1                       | 1103                    | 1                       |                            | -1                                   |
| Wastewater irrigation/M | 1                       | 28056                   | 14                      |                            | -14                                  |
| Nutrients               |                         |                         |                         |                            |                                      |
| N                       | 32 lb/an yr             |                         |                         | 6                          | 6                                    |
| P205                    | 42 lb/an yr             |                         |                         | 9                          | 9                                    |
| K20                     | 100 lb/an yr            |                         |                         | 13                         | 13                                   |
| Total                   |                         | 147615                  | 54                      | 29                         | -26                                  |

TABLE A-50. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, FLUSH, EARTHEN STORAGE, WASTEWATER IRRIGATION, 200 COWS

| Component               | Quantity               | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|------------------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 130 hrs                |                         | 5                       |                            | -5                                   |
| Tractor                 | 80 hrs                 |                         | 10                      |                            | -10                                  |
| Energy                  | 4400 kw                |                         | 2                       |                            | -2                                   |
| Concrete floor          | 90 ft <sup>2</sup> /an | 28028                   | 17                      |                            | -17                                  |
| Gated tank              | 2 @ 2000 gal           | 5460                    | 6                       |                            | -6                                   |
| Storage basin           | 110000 ft <sup>3</sup> | 4805                    | 3                       |                            | -3                                   |
| Recycle pump            | 1                      | 1103                    | 2                       |                            | -2                                   |
| Wastewater irrigation/M | 1                      | 14721                   | 19                      |                            | -19                                  |
| Nutrients               |                        |                         |                         |                            |                                      |
| N                       | 116 lb/an yr           |                         |                         | 23                         | 23                                   |
| P205                    | 76 lb/an yr            |                         |                         | 17                         | 17                                   |
| K20                     | 149 lb/an yr           |                         |                         | 19                         | 19                                   |
| Total                   |                        | 54116                   | 63                      | 59                         | -4                                   |

TABLE A-51. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, FLUSH, EARTHEN STORAGE, WASTEWATER IRRIGATION, 500 COWS

| Component               | Quantity               | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|------------------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 280 hrs                |                         | 4                       |                            | -4                                   |
| Tractor                 | 200 hrs                |                         | 10                      |                            | -10                                  |
| Energy                  | 11000 kw               |                         | 2                       |                            | -2                                   |
| Concrete floor          | 90 ft <sup>2</sup> /an | 66495                   | 16                      |                            | -16                                  |
| Gated tank              | 4 @ 2000 gal           | 10920                   | 5                       |                            | -5                                   |
| Storage basin           | 275000 ft <sup>3</sup> | 12012                   | 3                       |                            | -3                                   |
| Recycle pump            | 1                      | 1103                    | 1                       |                            | -1                                   |
| Wastewater irrigation/M | 1                      | 28056                   | 14                      |                            | -14                                  |
| Nutrients               |                        |                         |                         |                            |                                      |
| N                       | 116 lb/an yr           |                         |                         | 23                         | 23                                   |
| P205                    | 76 lb/an yr            |                         |                         | 17                         | 17                                   |
| K20                     | 149 lb/an yr           |                         |                         | 19                         | 19                                   |
| Total                   |                        | 118586                  | 55                      | 59                         | 4                                    |

TABLE A-52. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, FLUSH, SOLIDS SEPARATION, LAGOON, WASTEWATER IRRIGATION, 200 COWS

| Component               | Quantity               | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|------------------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 115 hrs                |                         | 5                       |                            | -5                                   |
| Tractor                 | 40 hrs                 |                         | 5                       |                            | -5                                   |
| Energy                  | 4400 kw                |                         | 2                       |                            | -2                                   |
| Concrete floor          | 90 ft <sup>2</sup> /an | 28028                   | 17                      |                            | -17                                  |
| Gated tank              | 2 @ 2000 gal           | 5460                    | 6                       |                            | -6                                   |
| Lagoons                 | 575000 ft <sup>3</sup> | 16416                   | 11                      |                            | -11                                  |
| Recycle pump            | 1                      | 1103                    | 2                       |                            | -2                                   |
| Wastewater irrigation/M | 1                      | 14721                   | 23                      |                            | -23                                  |
| Solids separator        | 1                      | 19320                   | 24                      |                            | -24                                  |
| Nutrients               |                        |                         |                         |                            |                                      |
| N                       | 26 lb/an yr            |                         |                         | 5                          | 5                                    |
| P205                    | 34 lb/an yr            |                         |                         | 7                          | 7                                    |
| K20                     | 80 lb/an yr            |                         |                         | 10                         | 10                                   |
| Total                   |                        | 85048                   | 94                      | 23                         | -71                                  |

TABLE A-53. ECONOMIC DATA FOR DAIRY, CONFINED FREE STALL, FLUSH, SOLIDS SEPARATION, LAGOON, WASTEWATER IRRIGATION, 500 COWS

| Component               | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 190 hrs      |                         | 3                       |                            | -3                                   |
| Tractor                 | 100 hrs      |                         | 5                       |                            | -5                                   |
| Energy                  | 11000 kw     |                         | 2                       |                            | -2                                   |
| Concrete floor          | 90 ft2/an    | 66495                   | 16                      |                            | -16                                  |
| Gated tank              | 4 @ 2000 gal | 10920                   | 5                       |                            | -5                                   |
| Lagoons                 | 1400000 ft3  | 41041                   | 11                      |                            | -11                                  |
| Recycle pump            | 1            | 1103                    | 1                       |                            | -1                                   |
| Wastewater irrigation/M | 1            | 28056                   | 14                      |                            | -14                                  |
| Solids separator        | 1            | 24780                   | 31                      |                            | -31                                  |
| Nutrients               |              |                         |                         |                            |                                      |
| N                       | 26 lb/an yr  |                         |                         | 5                          | 5                                    |
| P205                    | 34 lb/an yr  |                         |                         | 7                          | 7                                    |
| K20                     | 80 lb/an yr  |                         |                         | 10                         | 10                                   |
| Total                   |              | 172395                  | 88                      | 23                         | -65                                  |

TABLE A-54. ECONOMIC DATA FOR DAIRY, PASTURE YEAR AROUND, FLUSH MILKING FACILITY, LAGOON, WASTEWATER IRRIGATION, 200 COWS

| Component               | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 50 hrs       |                         | 2                       |                            | -2                                   |
| Tractor                 | 30 hrs       |                         | 3                       |                            | -3                                   |
| Energy                  | 1100 kw      |                         | 1                       |                            | -1                                   |
| Concrete floor          | 6 ft2/an     | 2317                    | 1                       |                            | -1                                   |
| Gated tank              | 2 @ 1000 gal | 4200                    | 4                       |                            | -4                                   |
| Storage basin           | 180000 ft3   | 10296                   | 7                       |                            | -7                                   |
| Wastewater irrigation/M | 1            | 14721                   | 19                      |                            | -19                                  |
| Recycle pump            | 1            | 1103                    | 2                       |                            | -2                                   |
| Nutrients               |              |                         |                         |                            |                                      |
| N                       | 7 lb/an yr   |                         |                         | 1                          | 1                                    |
| P205                    | 4 lb/an yr   |                         |                         | 1                          | 1                                    |
| K20                     | 14 lb/an yr  |                         |                         | 2                          | 2                                    |
| Total                   |              | 32636                   | 38                      | 4                          | -34                                  |

TABLE A-55. ECONOMIC DATA FOR DAIRY, PASTURE YEAR AROUND, FLUSH MILKING FACILITY, LAGOON, WASTEWATER IRRIGATION, 500 COWS

| Component               | Quantity     | Capital Investment (\$) | Annual Cost (\$/cow yr) | Annual Returns (\$/cow yr) | Annual Net System Return (\$/cow yr) |
|-------------------------|--------------|-------------------------|-------------------------|----------------------------|--------------------------------------|
| Labor                   | 125 hrs      |                         | 2                       |                            | -2                                   |
| Tractor                 | 75 hrs       |                         | 3                       |                            | -3                                   |
| Energy                  | 2750 kw      |                         | 1                       |                            | -1                                   |
| Concrete floor          | 6 ft2/an     | 5935                    | 1                       |                            | -1                                   |
| Gated tank              | 2 @ 2000 gal | 7560                    | 3                       |                            | -3                                   |
| Storage basin           | 450000 ft3   | 25740                   | 7                       |                            | -7                                   |
| Wastewater irrigation/M | 1            | 28056                   | 14                      |                            | -14                                  |
| Recycle pump            | 1            | 1103                    | 1                       |                            | -1                                   |
| Nutrients               |              |                         |                         |                            |                                      |
| N                       | 7 lb/an yr   |                         |                         | 1                          | 1                                    |
| P205                    | 4 lb/an yr   |                         |                         | 1                          | 1                                    |
| K20                     | 14 lb/an yr  |                         |                         | 2                          | 2                                    |
| Total                   |              | 68393                   | 31                      | 4                          | -27                                  |